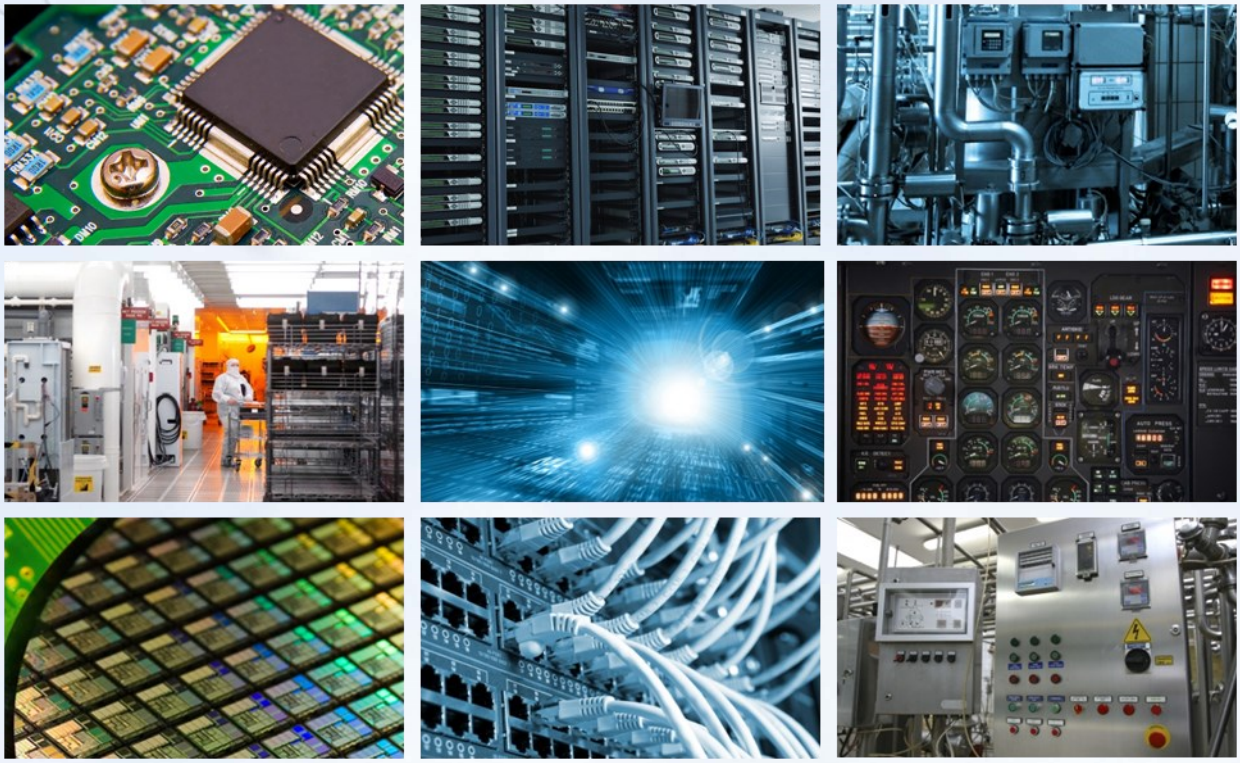
The Texas Electronics Industry



2013

TEXAS WIDE OPEN FOR BUSINESS

Contents

Texas High Tech Headlines

Apple breaks ground on $300 million expansion at Austin campus, plans to hire 3,600

See Page 9

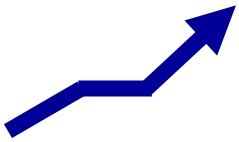
Ericsson begins $54 million expansion of U.S headquarters in Plano

See Page 24

Samsung Semiconductor continues construction on $4 billion expansion at Austin fab

See Page 11

Texas ranks #2 in electronics employment nationwide



See Page 5

Austin-based **National Instruments** to add 1,000 jobs at HQ

See Page 27

Texas public universities award more than 26,000 high tech-related degrees since 2009

See Page 7

Texas-based **Dell Inc.** to go private in $24 billion buyout

Dell operations info:
See Page 19

Semiconductor firms **Cirrus Logic** and **Maxim Integrated Products** build new corporate facilities in Texas

See Page 12

The Electronics Industry in Texas

The electronics industry is an important and growing part of the diverse Texas economy, directly employing over 196,000 across the state. Nationally, Texas ranks No. 2 in electronics employment and No. 3 in output. And, for the first time in 2012, Texas ranks No. 1 nationally in electronics exports.

Texas has been an electronics leader ever since the industry took off globally in the 1950s and Texas Instruments (TI) and other high tech companies established the state as a key tech hub. In fact, a TI engineer invented the integrated circuit in Dallas in 1958. Since then, the high tech electronics industry has spread its roots across the state with advances in semiconductors, computers, telecommunications, and, more recently, computer services.

Texas Electronics State Rankings:

No. 1 in Exports

No. 2 in Workforce

No. 3 in Value Added

Texas is an ideal location for electronics design and manufacturing firms, with a diverse and highly skilled workforce, a low-tax, business friendly environment, a large consumer market, access to leading research universities, and a rich history of technological innovation. Electronics firms in Texas also benefit from proximity to customers in related industries, including aerospace & defense, oil & gas, and automotive manufacturing.

Top Three Texas Electronics Giants

Dell

HQ: Round Rock

Computers, IT Services

$62.1 billion annual sales

Texas Instruments

HQ: Dallas

Semiconductors

$13.7 billion annual sales

Freescale Semiconductor

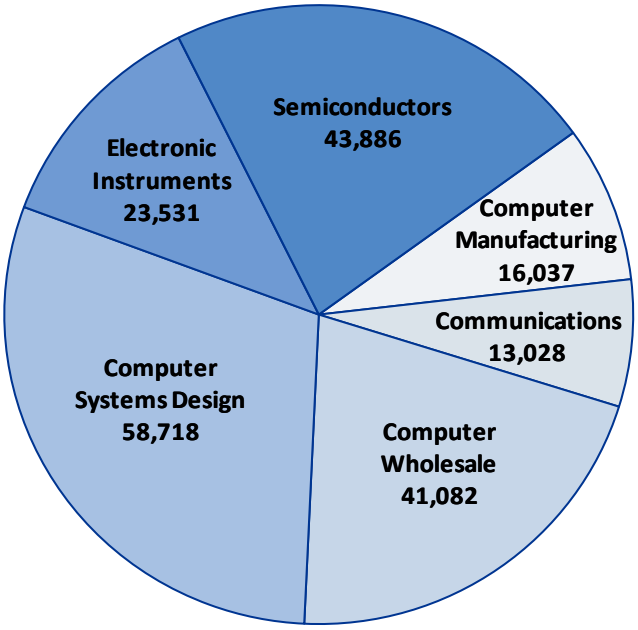
HQ: Austin

Semiconductors

$3.2 billion annual sales

Texas Electronics Employment

Second Quarter 2012, by Sector



Source: Texas Workforce Commission

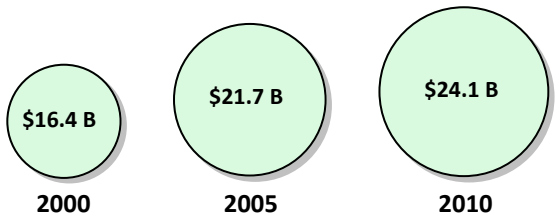
Data note: This report covers activities categorized in the North American Industry Classification System (NAICS): Computers & Peripheral Equipment Mfg. (3341); Communications Equipment Mfg. (3342); Semiconductor & Electronic Components Mfg. (3344); Semiconductor Machinery Mfg. (333242); Electronic Instrument Mfg. (3345); Computer Wholesalers (423430); and Computer Systems Design (541512).

State of the Industry

In 2010, Texas ranked No. 3 nationally for electronics manufacturing output, accounting for nearly 10% of the U.S. total electronics manufacturing value, as measured by gross domestic product (GDP).

Output of the Texas Electronics Industry

From 2000-2010, the (GDP) of the Texas electronics manufacturing industry grew from $16.4 billion to $24.1 billion, a 47% increase.



Source: U.S. Bureau of Economic Analysis

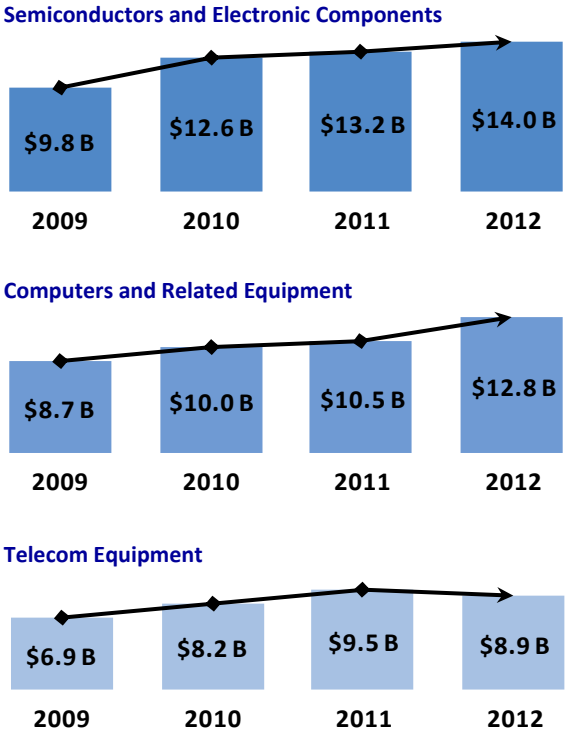
Texas Claims Spot as Nation's No. 1 Electronics Exporting State

In 2012, Texas ranked No. 1 in the U.S. for electronics exports, with over $42.4 billion in electronic products shipped internationally. Texas electronics exports rose 9% in 2012 to edge out California for this top spot. Mexico is the top destination for these goods, with nearly half of all Texas electronics exports heading to its southern neighbor.

Electronics was the third largest export sector for Texas, behind petroleum products and chemicals. Overall, Texas has been the top exporting state for 11 straight years.

Electronics Exports from Texas

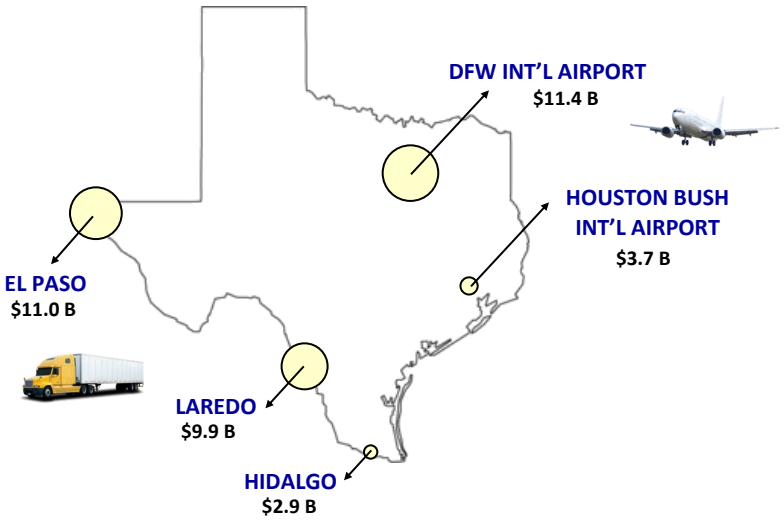
Total value of shipments from Texas to international markets (in billions of U.S. dollars) by Sector



Source: U.S. Census Bureau

Top Five Texas Ports for Electronics Exports

By total value of international shipments (in billions, 2012)



Major Electronics Companies in Texas

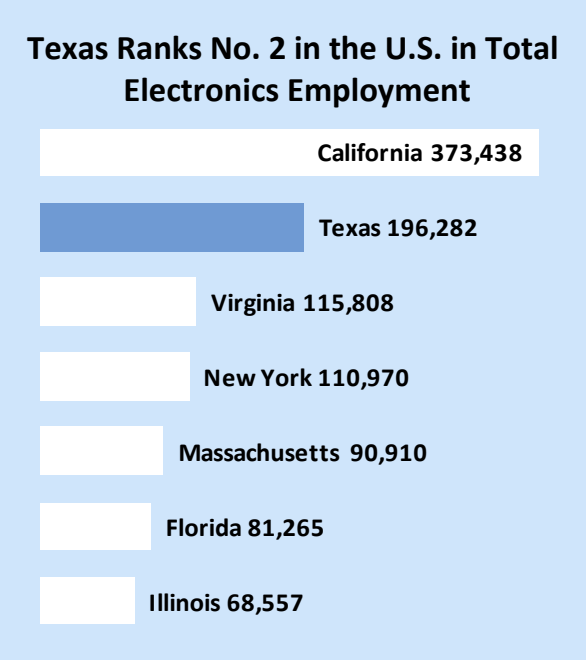
Select firms with corporate, research, or manufacturing facilities in the state

Representative sample only.
Map does not include all company locations.

Texas Electronics Workforce

Texas' electronics workforce is the second largest in the nation, with more than 137,500 professionals employed directly in hardware manufacturing and sales, and an additional 58,700 employed in computer systems design. The second largest electronics sector in the state is semiconductor and electronic component manufacturing, which includes integrated circuits, microprocessors, memory chips, and printed circuit boards and assemblies. This sector accounts for nearly 22% of electronics employment in Texas (see table below).

The Texas workforce is significantly more specialized in electronics manufacturing than other U.S. states, measured by electronics workers per capita. The percentage of Texas workers employed in semiconductor, computer, and telecom manufacturing is 30%-40% greater than the national average.



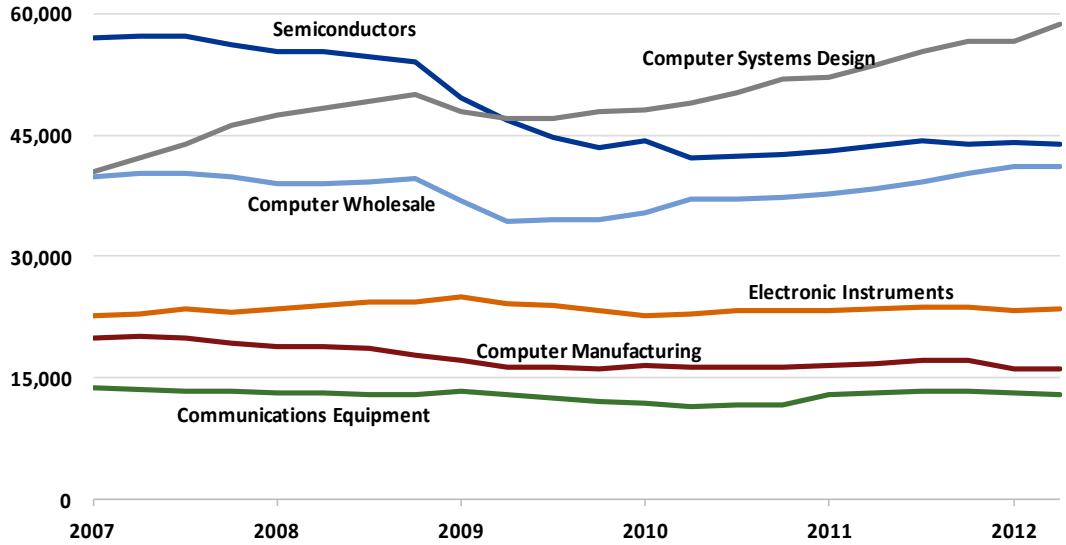
Source: U.S. Bureau of Labor Statistics

Electronics-Related Employment in Texas
Second Quarter 2012

Sector (Industry Code)	Employees	Firms	Average Annual Wage
Computers and Peripheral Equipment Mfg. (3341)	16,037	95	$122,148
Communications Equipment Manufacturing (3342)	13,028	154	$109,252
Semiconductor and Electronic Components Mfg. (3344)	43,236	346	$95,212
Semiconductor Machinery Manufacturing (333242)	650	24	$82,316
Electronic Instrument Manufacturing (3345)	23,531	493	$84,604
Computers, Peripheral Equip. & Software Wholesale (423430)	41,082	765	$103,064
Computer Systems Design Services (541512)	58,718	6,800	$88,660
TOTAL	**196,282**	**8,677**	**$96,714**

Source: Texas Workforce Commission

Texas 5-Year Employment Trends by Sector, 2007 to 2012



Source: Texas Workforce Commission. Q1 2007 to Q2 2012

Mirroring national trends, electronics manufacturing employment in Texas decreased by roughly 15% from 2007-2012. As shown in the above chart, jobs in the state's semiconductor sector were most affected, declining by 24%, as the industry continued to undergo significant consolidation globally. Although electronics production employment contracted statewide, significant employment gains were seen in non-manufacturing sectors of the industry during this period. The computer systems design sector, which includes hardware and software design, as well as the computer equipment wholesale sector, which includes post-assembly distribution and services, both added significant numbers of Texas jobs, particularly starting in late 2009. Additionally, despite declining head counts at Texas electronics firms, the state's electronics industry output increased by 47% from 2000-2010, due to productivity gains (see output chart on page 3).

Patents and Venture Capital

Texas' continued strength in the electronics industry is due in large part to the growing pipeline of electronics-related patents and venture capital in the state.

- Texas' annual **high-tech patent output increased by 37%** from 2001-2011, and Texas ranked No. 2 nationally in 2011 for total high-tech patents, according to the U.S. Patent and Trademark Office (USPTO).
- In July 2012, **Dallas was selected** as a location for one of four new USPTO satellite locations. Dallas was chosen in part because of the state's growing output of high-tech innovations. The office is expected to open in 2013.
- From 2002-2012, **venture capital firms invested nearly $5 billion** in Texas electronics companies, according to PricewaterhouseCoopers.

Electronics Education in Texas

Number of Electronics-Related Degrees Awarded, 2009-2012

All Texas Public Universities, All Degree Levels

Electrical, Electronics and Telecom Engineering		7,639
Computer and Software Engineering		1,951
Computer Science		8,048
Information Science & Technology		2,064
Mathematics and Physics		6,470
TOTAL		**26,172**

Source: Texas Higher Education Coordinating Board

Top Ten Texas Universities for Electronics-Related R&D

by FY 2011 Expenditures

Institution	Total R&D (Millions)
University of Texas (UT) at Austin	$63.2
Texas A&M University	$49.1
Rice University (Houston)	$41.9
UT at Arlington	$12.4
Texas Tech University (Lubbock)	$12.0
UT at El Paso	$9.7
University of Houston	$9.0
UT at Dallas	$5.3
UT at San Antonio	$3.5
University of North Texas (Denton)	$2.3
TOTAL	**$218.0**

Source: Texas Higher Education Coordinating Board

Texas in Top Tier for Tech-Related Doctorates

In 2011, the National Science Foundation ranked Texas among the top tier of U.S. states for number of doctorates awarded in tech-related fields:

- No. 3 for **All Doctorates Awarded**
- No. 2 for **All Engineering**
- No. 2 for **Electrical Engineering**
- No. 3 for **Computer and Info Science**
- No. 4 for **Mathematics**

State Government Initiatives

Incentive Programs

In 2003, the Texas Legislature passed legislation authorizing the $295 million Texas Enterprise Fund (TEF), a "deal closing" fund created to attract businesses and new jobs to Texas. The Legislature reauthorized the TEF most recently in 2011. As of December 2012, the TEF has awarded approximately $137 million to electronics industry-related projects. The table shown below details these projects and the 11,921 jobs they have committed to create.

the TEF has awarded more than $133 million to electronics-related projects.

In 2005, Gov. Rick Perry and the Texas Legislature authorized the $200 million Texas Emerging Technology Fund (TETF) to promote breakthrough technological innovations across multiple industries, including electronics. The TETF was reauthorized most recently in 2011. To date, the TETF has awarded $92 million to electronics industry-related projects, with nearly $46 million going to commercialize 33 start-up companies and over $46 million awarded to universities and research consortia. For details on high tech industry-related TETF awards, see the Appendix on page 30.

Education Initiatives

In 2005, the Texas Legislature established the Texas Science, Technology, Engineering and Mathematics (T-STEM) Initiative. Modeled on national STEM programs, T-STEM focuses on educating and graduating

Texas Enterprise Fund
Awards to the Electronics Industry

Company	City	Sector	Jobs	Award (Millions)
Apple	Austin	Computer Software/Hardware	3,635	$21.0
HelioVolt	Austin	Solar Panels	158	$1.0
HID Corp	Austin	Electronic ID System Mfg.	239	$1.9
Maxim Integrated Products	San Antonio	Semiconductor Mfg.	500	$1.5
Medtronic	San Antonio	Electromedical Devices	1,384	$6.0
National Instruments	Austin	Electronic Instruments	1,000	$4.4
Rockwell Collins	Richardson	Aviation Electronics	105	$0.8
Samsung Austin Semiconductor	Austin	Semiconductor Mfg.	900	$10.8
SEMATECH	Austin	Semiconductor Consortium	4,000	$40.0
Texas Instruments/ The University of Texas at Dallas	Richardson	Semiconductor Research & Mfg.	NA	$50.0
		TOTAL	**11,921**	**$137.4**

Texas Enterprise Fund

Apple Doubles Size of Texas Corporate Campus

In March 2012, Apple unveiled plans for a $300 million expansion of its corporate campus in Austin, Texas, where the company expects to add over 3,600 jobs in accounting, customer support, and sales operations. The project, supported by $21 million from the Texas Enterprise Fund and an estimated $15 million from the City of Austin and Travis County, will roughly double Apple's Austin workforce and establish the Texas capital as the company's largest employment base.

Elsewhere in Austin, Apple also employs approximately 100 workers at a microchip design center, which became part of the company in 2010 when Apple acquired Austin-based Intrinsity. Apple's Austin network further extends to multiple component suppliers based in the city, including Samsung Austin Semiconductor and Cirrus Logic, which both provide chips for use in Apple's iPhone and iPad mobile devices. Beyond Austin, Dallas-area semiconductor firms Texas Instruments and Diodes Inc. also supply Apple with components for its mobile devices.

more Texas students in STEM fields critical for maintaining a skilled and competitive state workforce. T-STEM is part of the Texas High School Project and aims to more closely align high school curriculums with admission requirements for competitive colleges. Under the initiative, 51 T-STEM academies have been created, serving approximately 15,000 students annually. The Legislature most recently reauthorized the program in 2011.

Tax Legislation

State sales and use tax exemptions are available to all manufacturers in Texas. The exemptions apply to the purchase or rental of manufacturing machinery, inputs & raw materials, safety equipment, pollution control equipment, semiconductor & biotech clean rooms, and chemicals used in the manufacturing process. Sales tax exemptions are especially useful to high-tech electronics manufacturers such as semiconductor foundries, who typically have large outlays on manufacturing equipment.

Texas Emerging Technology Fund

Calxeda Serves Data Center Efficiency

Founded in Austin in 2008, Calxeda is focused on bringing more efficient system-on-chip designs into servers and cloud services. The company has partnered with major server manufacturers, including Dell, to commercialize this technology. Calxeda received $1 million in funding from the Texas Emerging Technology Fund (TETF) in 2009.

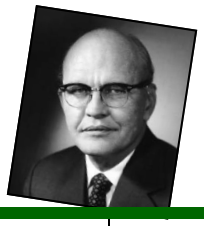
Molecular Imprints Advances Semiconductors at the Nanoscale

Molecular Imprints is an Austin-based provider of advanced lithography equipment which enables semiconductor manufacturers to create microchip features at the nanoscale level. The company made its first commercial delivery in 2011 and is currently ramping up to full production. The TETF invested $3 million in Molecular Imprints in 2006.

Texas: A Long History of High-Tech Innovation

1940s: Geophysical Service Inc, the fore-runner to Texas Instruments, makes submarine detection devices for U.S. Navy during WWII

1954: Texas Instruments (TI) commercializes the first silicon transistor and transistor radio



1957: Collins Radio locates in Richardson, Texas, planting seeds of the North Texas telecom cluster

1958: TI engineer Jack Kilby invents the integrated circuit in Dallas, Texas

1962: TI sells first integrated circuit systems to the U.S. Air Force

1967: The hand-held calculator invented by TI

1971: TI patents the microprocessor, the first device to combine all computing components onto a single chip

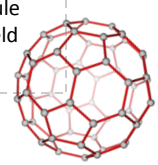
1982: The Microelectronics and Computer Consortium (MCC), the country's first computer industry R&D consortium, locates in Austin, Texas

1982: Compaq, the global PC sales leader for much of the 1990s, founded in Houston

1984: Dallas Semiconductor founded (now part of Maxim Integrated Products)

1984: Michael Dell founds a computer company out of his dorm room in Austin

1985: Three professors at Rice Univ. in Houston discover the molecule that launches the field of nanotechnology



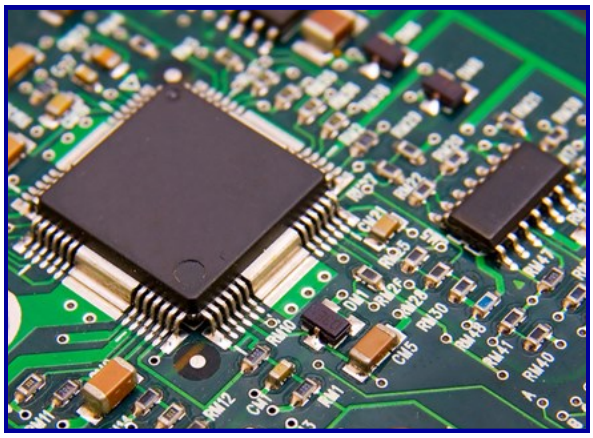
1987: U.S. semiconductor manufacturers form the SEMATECH consortium in Austin

2004: Freescale Semiconductor founded in Austin as spin-off from Motorola

1996: In Austin, Samsung opens its first and only semiconductor fab outside of South Korea

2009: TI opens RFAB, a state-of-the-art, 12-inch semiconductor foundry, in Richardson

Semiconductors



Texas has been a global leader in semiconductors from the industry's beginnings. In 1958, Texas Instruments (TI) engineer Jack Kilby invented the breakthrough integrated circuit in Dallas, an invention which would go on to earn him the Nobel Prize in Physics in 2000. In the meantime, the technology developed at TI helped Texas become a global electronics powerhouse.

Today, Texas' semiconductor and electronic component workforce is the second largest in the nation, with 370 firms employing nearly 44,000 workers. Semiconductors, also called microchips or integrated circuits (ICs), contain millions of microscopic transistors connected together to form the brains of computers, smartphones, and televisions. This is the second-largest electronics industry sector in Texas, accounting for 22% of the state's electronics employment.

Within the Texas semiconductor and electronic component manufacturing sector (NAICS 3344), 29,000 workers are employed at semiconductor companies such as TI, Freescale, Samsung, and others. Three related manufacturing subsectors—bare printed circuit boards (PCBs), printed circuit assemblies (PCAs) and other electronic components—each employs between 3,000 and 5,000 additional workers at companies including Celestica and Sanmina-SCI. Elsewhere, at companies like TT Electronics, another 2,000 work in the electronic coil, transformer, and connector subsectors. Lastly, semiconductor machinery manufacturing, another related subsector that produces equipment for semiconductor fabs, employs more than 600. Applied Materials leads this subsector, both globally and in Texas. Major companies across the Texas semiconductor industry are listed on pages 14-15.

Texas' semiconductor workforce is the second largest in the nation

The semiconductor industry evolves constantly and cutting-edge technology can become obsolete in a matter of years. The rapid progress observed in the semiconductor industry is embodied in Moore's Law, a rule of thumb which states that the amount of

Samsung Continues $4 Billion Expansion in Austin

Samsung made headlines in 1996 when the company selected Austin, Texas for the company's first and only semiconductor foundry in the U.S. Samsung Austin Semiconductor expanded in 2003, 2006, 2010, and 2012, with a cumulative capital investment of over $13 billion. A $10.8 million Texas Enterprise Fund award supported the 2006 expansion, which resulted in a $2.5 billion investment and 900 new jobs.

The company's latest expansion in 2012 amounted to $4 billion, which is one of the single largest foreign direct investment in Texas history. Including a chip design center established in 2010 in Austin, Samsung now employs approximately 2,500 in Central Texas.

transistors contained in a microchip will double every 2 years. In 1971, the first commercial microchip contained 2,300 transistors. In 2012, popular computer chips had around 1.4 billion transistors crammed onto their surface. As transistors on each microchip have gotten smaller and more numerous, the size of state-of-the-art silicon wafers has grown from 5 inches in 1985 to 12 inches today. This leads to enormous efficiencies in production, but at a vastly greater expense. For example, a 6-inch semiconductor fab in 1985 cost around $100 million, while in 2012 a 12-inch fab requires an investment of over $5 billion. The trend of separating design and manufacturing is likely to continue, as the industry transitions to 18-inch silicon wafers in the next five to ten years.

From 2007-2011, employment in the semiconductor and electronic components industry in Texas decreased by 19%. Industry trends have led to consolidation in manufacturing around semiconductor foundries and a proliferation of fabless semiconductor companies that design microchips but outsource production. As a result of this consolidation, the most advanced semiconductor foundries today are much larger and more capital intensive, so fewer companies can afford to operate them profitably. A profile of semiconductor foundries in Texas is featured on pages 16-17.

Texas semiconductor companies received $1.2 billion in venture capital from 2002-2012

Although semiconductor manufacturing is on a consolidation trend, other industry subcategories have added jobs in recent years. Electronic coil & transformer, semiconductor machinery, and printed circuit assemblies manufacturers all added jobs in Texas between 2007 and 2011 (see chart on page 13).

The Texas semiconductor industry has continued to attract strong venture capital (VC) interest. From 2002 through 2012, VC firms invested nearly $1.2 billion in Texas semiconductor companies, according to PriceWaterhouseCoopers. Furthermore, the state's Texas Emerging Technology Fund has invested approximately $62.4 million in 19 semiconductor-related projects. See page 30 for more details.

Semiconductor Companies Build New Corporate Facilities in Texas

Maxim Integrated Products, a California-based semiconductor firm, celebrated the opening of its expanded Farmers Branch campus in March 2012. The company invested $22 million in the project.

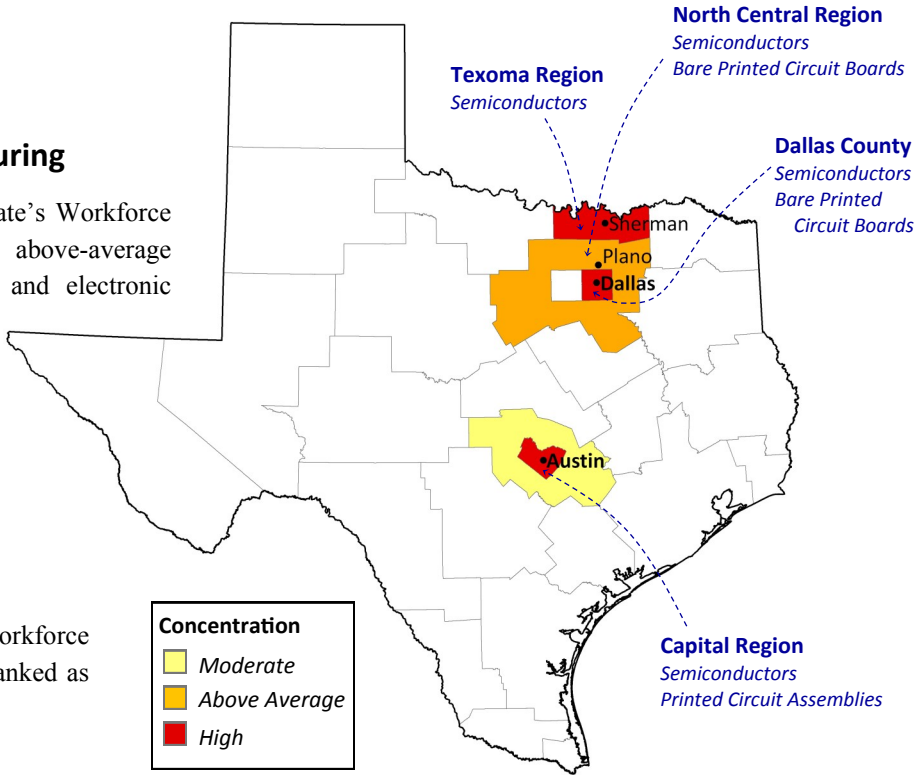
Following several years of rapid growth, chip design firm **Cirrus Logic** moved into its newly constructed headquarters and circuit testing facility in downtown Austin in July 2012.

Workforce Concentrations

Semiconductor Manufacturing

The map at right identifies the state's Workforce Development regions with above-average specializations in semiconductor and electronic component manufacturing. The highlighted regions are not the only areas in Texas where workers in this sector can be found, but rather represent areas with the greatest concentrations relative to the size of the local labor force.

Regions with significant workforce concentrations in this sector are ranked as moderate, above average, or high.



Source: Texas Workforce Commission

Semiconductor and Electronic Components Manufacturing Employment in Texas
Second Quarter 2012

Subsector (Industry Code)	Employees	Firms	Average Annual Wage
Bare Printed Circuit Board Manufacturing (334412)	4,375	49	$62,660
Semiconductor and Electronic Components Manufacturing (334413)	28,897	131	$104,052
Electronic Coils, Transformer & Inductor Manufacturing (334416)	1,138	22	$40,092
Electronic Connector Manufacturing (334417)	894	13	$51,636
Printed Circuit Assemblies Manufacturing (334418)	3,001	62	$61,464
Other Electronic Component Manufacturing (334419)	4,931	79	$113,568
Semiconductor Machinery Manufacturing (333242)	650	24	$82,316
TOTAL	**43,886**	**370**	**$95,021**

Source: Texas Workforce Commission

Major Companies

Top Semiconductor & Semiconductor Machinery Manufacturers with Operations in Texas

Alphabetical

Company Name	Primary Location(s)	Sector	Global Sales (Millions)
Applied Materials	Austin	Semiconductor Equipment	$8,719
Benchmark Electronics	Angleton	Printed Circuit Board Manufacturing	$2,253
Celestica	Austin	Printed Circuit Board Manufacturing	$7,213
Creation Technologies	Plano	Printed Circuit Board Manufacturing	*NA*
Ducommun LaBarge	Stafford	Printed Circuit Assembly	$581
Freescale Semiconductor	Austin	Semiconductor Design & Foundry	$3,217
Horiba Instruments	Austin, Richardson	Semiconductor Machinery	$1,595
Maxim Integrated Products	Austin, Dallas, San Antonio	Semiconductor Design & Foundry	$2,404
MEMC Electronic Materials	Pasadena	Polysilicon Manufacturing	$2,716
Samsung Austin Semiconductor	Austin	Semiconductor Design & Foundry	$104,155
Sino-American Silicon (GlobiTech subsidiary)	Sherman	Silicon Wafer Manufacturing	$576
Spansion	Austin	Semiconductor Design & Foundry	$1,070
Texas Instruments	Dallas, Austin, Plano, Richardson, Sherman, Sugar Land	Semiconductor Design & Foundry	$13,735
Novati Technologies (Tezzaron Subsidiary)	Austin	Semiconductor Design & Foundry	*NA*
Tokyo Electron	Austin	Semiconductor Equipment	$7,694
Toppan Photomasks	Round Rock	Semiconductor Equipment	$18,356
TriQuint Semiconductor	Richardson	Semiconductor Design & Foundry	$896
Ultra Clean Technology	Austin	Semiconductor Equipment	$453
X-FAB	Lubbock	Semiconductor Design & Foundry	$85

Representative sample only. Sources: D&B, LexisNexis, company websites

Top Fabless Semiconductor Companies with Operations in Texas

Alphabetical

Company Name	Primary Location(s)	Sector	Global Sales (Millions)
Advanced Micro Devices (AMD)	Austin, Houston	Semiconductor Design	$6,568
Altera Corp.	Austin	Semiconductor Design	$2,064
Apple (formerly Intrinsity)	Austin	Semiconductor Design	$156,508
ARM Inc	Austin, Plano	Semiconductor Design	$760
Cirrus Logic	Austin	Semiconductor Design	$427
Diodes Inc.	Plano	Semiconductor Design	$635
IBM	Austin	Semiconductor Design	$106,916
Intel	Austin	Semiconductor Design	$53,999
Marvell Semiconductor	Austin, Houston	Semiconductor Design	$3,393
MediaTek Wireless	Austin	Semiconductor Design	$2,852
Microchip Technology (SMSC subsidiary)	Austin	Semiconductor Design	$1,383
Micron Technology	Allen	Semiconductor Design	$8,234
Microsemi (Zarlink Semiconductor subsidiary)	Austin	Semiconductor Design	$1,013
NVIDIA	Austin, Richardson	Semiconductor Design	$3,998
NXP Semiconductors	Austin	Semiconductor Design	$4,194
ON Semiconductor	Austin, Plano	Semiconductor Design	$3,442
PMC-Sierra	Austin	Semiconductor Design	$654
Qualcomm	Austin	Semiconductor Design	$19,121
RF Micro Devices	Richardson	Semiconductor Design	$871
Silicon Labs	Austin	Semiconductor Design	$492
STMicroelectronics	Coppell	Semiconductor Design	$9,735

Representative sample only. Sources: D&B, LexisNexis, company websites

Semiconductor Foundries in Texas

Freescale Semiconductor

Austin, Texas

- Global HQ and design center in Austin, Texas
- Two 200mm wafer fabs in Austin:
  Austin Technology & Manufacturing Center - microprocessor chips
  Oak Hill Fab - analog/mixed signal devices
- Spin off from Motorola in 2004

Maxim Integrated Products

Dallas and San Antonio, Texas

- 200mm wafer fab in San Antonio
- Design center & 200mm bump fab in Dallas area
- Design center in Austin
- Acquired Dallas Semiconductor in 2001
- Global HQ in San Jose, California

Samsung Austin Semiconductor

Austin, Texas

- Built in 1996
- Announced $4 billion expansion in 2012
- 300mm wafer fab
- Makes chips for smartphones and tablets
- Design center also located in Austin
- Employs 2,500 in Central Texas

Spansion

Austin, Texas

- 200mm wafer fab & design center
- Produces chips for flash memory
- Former AMD-Fujitsu joint venture, now independent
- Global HQ in Sunnyvale, California

Texas Instruments

Dallas, Richardson, and Sherman, Texas

- Operates five foundries in Sherman, Richardson, and Dallas
- 300mm Richardson fab opened in 2006
- Design centers in Dallas, Austin, and Stafford
- Employs 9,100 in North Texas alone
- Acquired National Semiconductor in 2011
- Global HQ in Dallas

Novati Technologies (Tezzaron Semiconductor)

Austin, Texas

- Acquired from SVTC in 2012
- Produces 200mm & 300mm wafers
- Shared-use development & commercialization fab
- Built in 1988 by the SEMATECH consortium
- Global HQ in Naperville, Illinois

TriQuint Semiconductor

Richardson, Texas

- Purchased Richardson fab in 2000
- 100mm & two 150mm fabs on site
- Makes chips for mobile devices, networks, and aerospace & defense
- In-house design & foundry services
- Global HQ in Hillsboro, Oregon

X-FAB

Lubbock, Texas

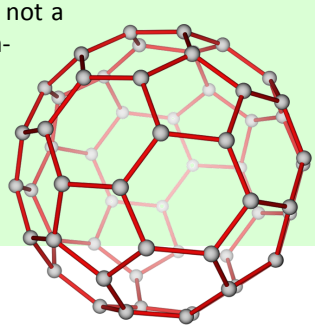
- 200mm fab
- Global HQ in Erfurt, Germany
- Former Texas Instruments facility
- Provides foundry services for analog/mixed-signal chips

Rice University: Birthplace of Nanotechnology

Richard Smalley, Robert Curl, and Harold Kroto first discovered fullerenes, soccer ball-shaped carbon molecules 1-nanometer in diameter, in 1985 at Rice University in Houston, Texas, thus beginning an age of nanoscience discovery. In 1996, the three co-discoverers were awarded the Nobel Prize in Chemistry for their breakthrough.

Since that landmark event, Rice University and Dr. Smalley have been leaders in nanotechnology development, establishing the world's first nanotech research institution in 1993. The Richard E. Smalley Institute for Nanoscale Science and Technology, posthumously renamed in honor of its founder in 2005, is a leader in nanotech research across all disciplines.

Nanotechnology is incredibly promising because some materials can have different physical, chemical, and electrical properties when assembled at the molecular level. Nanotechnology is not a specific industry, but is rather an enabling technology that underpins new innovations across a range of high tech industries, including manufacturing, aerospace & defense, renewable energy, biotechnology, and electronics. For the past 10 years, integrated circuits have been manufactured at the nanoscale level (with details smaller than 100 nm) in the semiconductor industry.



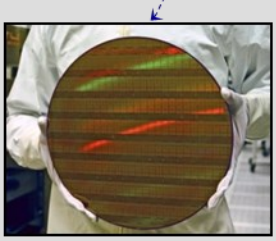
Buckminsterfullerene, or "Buckyball"

The Semiconductor Manufacturing Process

Semiconductor manufacturing is a complex multi-stage process. Here's the short version:

Ingots of monocrystalline silicon are sliced into wafers

The processing stage involves etching features and depositing materials at the nanoscale level. This is done in clean rooms to prevent impurities



A 12-inch silicon wafer contains hundreds of integrated circuits

The chips are broken up and placed into a supporting package (black), ready for installation onto a printed circuit board (green)

Computers & Related Equipment

As home to the global headquarters of computer giant Dell, as well as corporate campuses of Hewlett-Packard and Apple, Texas has long been one of the leading U.S. states in the computer sector. In 2012, Texas ranked No. 2 in the country for computer sector employment, behind only California. This sector includes manufacturers of computers, servers, and peripheral equipment such as monitors, as well as firms involved in designing or marketing computer equipment manufactured by a third party.

Texas staked its claim as a top computer manufacturing state in the 1980s, when PC makers Dell and Compaq (now part of HP) were founded in the state. Jobs in this sector grew rapidly in Texas through much of the 1990s, peaking at over 33,000 in 2000. During the past decade, employment in the sector followed national trends, contracting significantly as manufacturing operations consolidated, improved productivity, or shifted to foreign countries. Despite these trends, Texas remains one of the top U.S. states for computer manufacturing employment with more than 16,000 workers, primarily in the Austin and Houston areas.

Jobs in computer systems design surged by 60% from 2002-2012

By far the largest subsector of this industry by employment is computer systems design services, which employs nearly 60,000 in Texas. Employment in this subsector, which includes design of hardware and software systems, surged by 60% in Texas from 2002-2012, making it one of the most important job growth segments in the state (see chart on page 20).

Dell Manufacturing: Austin, Texas

Dell's Enterprise Manufacturing plant in Austin, known internally as PN1, is one of four manufacturing facilities worldwide—and the only one in the U.S.—that produces the company's PowerEdge Servers, Precision workstations, and Data Center Solutions. The Austin plant, which serves the North American markets, is one of Dell's most flexible plants, according to the company, due to its highly flexible workforce, lean line designs, and point-of-use supply chain.

HP Manufacturing: Houston, Texas

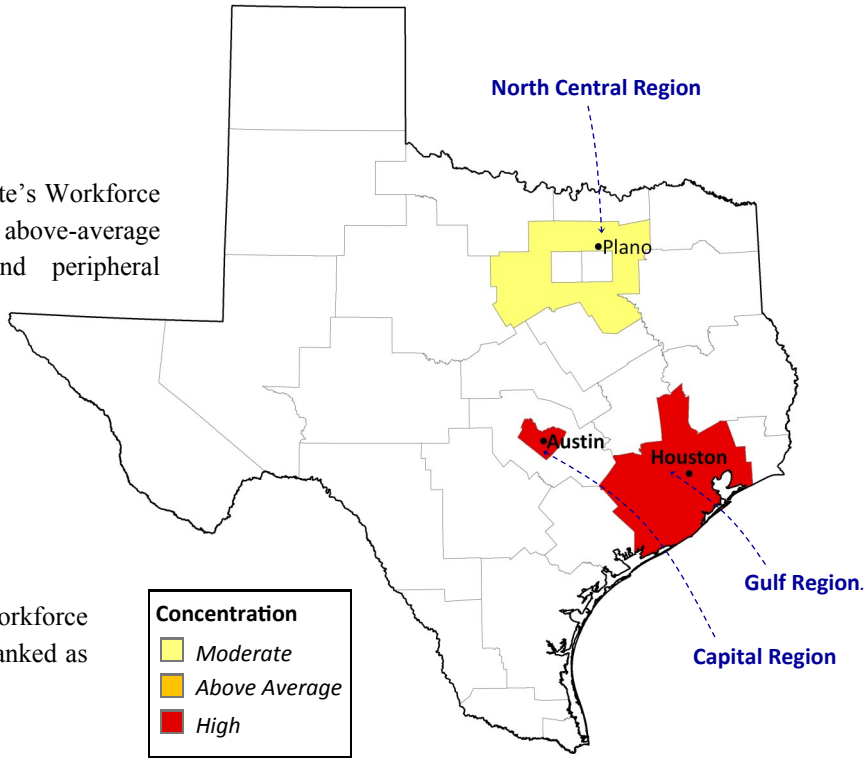
HP's Factory Express and PodWorks manufacturing facilities in northwest Houston produce preconfigured data center containers ("PODS") and other server and networking products. The company ships 2,500 servers a day from its Houston facilities, which operate 24 hours a day, five days a week. The Houston campus, which originally served as the corporate headquarters of Compaq until its acquisition by HP in 2002, also houses an HP PC design studio.

Workforce Concentrations

Computer Manufacturing

The map at right identifies the state's Workforce Development regions with above-average specializations in computer and peripheral equipment manufacturing. The highlighted regions are not the only areas in Texas where workers in this sector can be found, but rather represent areas with the greatest concentrations relative to the size of the local labor force.

Regions with significant workforce concentrations in this sector are ranked as moderate, above average, or high.



Source: Texas Workforce Commission

Computer Manufacturing and Related Employment in Texas
Second Quarter 2012

Subsector (Industry Code)	Employees	Firms	Average Annual Wage
Electronic Computer Manufacturing (334111)	12,644	47	$128,544
Computer Storage Device Manufacturing (334112)	107	9	$119,080
Other Computer Peripheral Equipment Manufacturing (334118)	3,286	39	$97,637
Computers, Peripheral Equip. & Software Wholesale (423430)	41,082	765	$103,064
Computer Systems Design Services (541512)	58,718	6,800	$88,660
TOTAL	**115,837**	**7,660**	**$98,405**

Source: Texas Workforce Commission

Major Companies

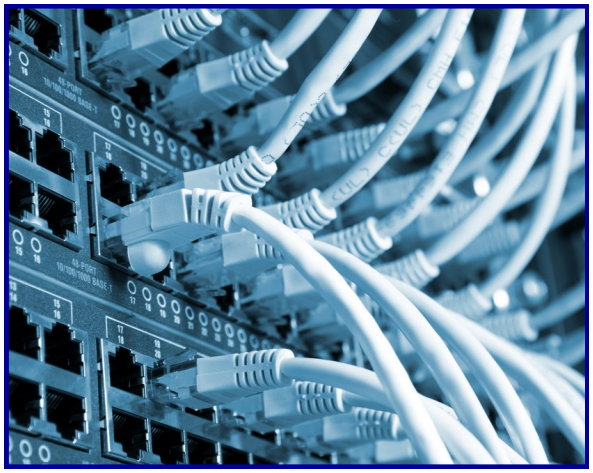
Top Computer Equipment Manufacturers with Operations in Texas

Alphabetical

Company Name	Primary Location(s)	Sector	Sales (Millions)
Apple	Austin	Computer & Telecom Equipment	$156,508
Buffalo Technology	Austin	Computer Equipment	$1,184
Dell	Round Rock, Austin	Computers	$62,071
Flextronics	Irving, Austin, Plano, Stafford, Longview	Computer Equipment & Printed Circuit Boards	$29,388
Foxconn	Houston, Austin	Computer Equipment	$113,386
Hewlett Packard	Houston, Austin	Computers	$120,357
NEC Corporation	Irving	Computers & Telecom Equipment	$36,907
Sanmina-SCI	Carrollton, Austin	Computer Equipment & Printed Circuit Boards	$6,093
Touch International	Austin	Computer Equipment	$49
Xplore Technologies	Austin	Computers	$28

Representative sample only. Sources: Dun & Bradstreet, LexisNexis, company websites

Communications Equipment



The U.S. communications equipment sector is heavily concentrated in Texas, where the percentage of the workforce employed by communications equipment firms is more than double the national average. Texas ranks No. 2 in the U.S. for total jobs in the sector, with more than 13,000 workers, and Texas communications companies ship nearly $5 billion in equipment annually, from product lines including wired telephone switching equipment, routers, and wireless apparatuses like radio and TV broadcasting, mobile communications, and GPS systems.

In Texas, communications equipment employment is evenly divided between two subsectors—wired and wireless equipment. Job trends, however, are diverging. From 2007 to 2011, wired telecom employment fell 19%, while wireless telecom employment rose 24%.

Aside from manufacturing occupations, which make up about a quarter of total communications equipment employment, companies in Texas also employ a large number of workers in software and R&D roles. More than a third of all jobs in this sector are engineering or information technology related. Additionally, related service sectors also play a major role in the state's communications industry. Nearly 86,000 workers in Texas, for example, provide telecommunications services, while an additional 29,000 work in data management and hosting services.

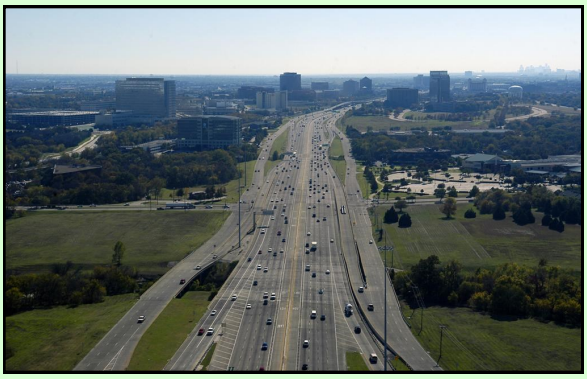
Texas ranks **No. 2** in the U.S. for jobs in the communications equipment sector

The Texas communications sector has attracted strong venture capital (VC) support over the past ten years. From 2002-2012, VC firms invested nearly $2.25 billion in 236 Texas telecom and networking equipment deals, according to Pricewaterhouse-Coopers. Additionally, the state's Texas Emerging Technology Fund has invested approximately $11.4 million in nine computer and telecom-related projects since 2005. See page 30 for more details.

Communications Equipment Manufacturing Employment in Texas
Second Quarter 2012

Subsector (Industry Code)	Employees	Firms	Average Annual Wage
Telephone Apparatus Manufacturing (334210)	5,606	36	$115,180
Broadcast & Wireless Communication Equipment Mfg (334220)	5,663	78	$108,836
Other Communications Equipment Manufacturing (334290)	1,759	41	$91,780
TOTAL	**13,028**	**154**	**$109,252**

Source: Texas Workforce Commission



How North Dallas Became the Nation's Telecom Capital

As home to more than 70% of all jobs in the Texas communications equipment sector, North Texas is the state's leading telecom region. At its center is the suburb of Richardson, which has earned the nickname the "Telecom Corridor®," due to its concentration of corporate facilities. The regional cluster began in the mid-1950's, when semiconductor firm Texas Instruments selected a site near the corner of U.S. 75 and I-635 for its corporate campus. Shortly after, in 1957, Iowa-based electronics maker Collins Radio began building what would become a multi-structure, 400-acre campus north of Texas Instruments along U.S. 75. Both companies attracted a large pool of engineering talent and eventually spawned a number of local high-tech start-ups. Collins Radio was acquired by Rockwell in 1971.

The pace of the telecom cluster's growth accelerated in the 1980s with the deregulation of the telecommunications industry. First came MCI, whose microwave network relied on the products and technical expertise of Collins Radio/Rockwell, which was acquired by Alcatel in 1991. Around the same time, Nortel, Fujitsu, and Ericsson established major operations in Richardson to benefit from the technical expertise that made this region a world-class center for telecom and other technology businesses.

Source: Metroplex Technology Business Council

Texas Attracts Telecom Industry Investment from around the World

Telecom equipment is one of the top five industries for foreign direct investment (FDI) in Texas, measured by number of investment projects. According to consulting firm fDi Intelligence, Texas ranked No. 3 in the U.S. for telecom FDI projects from 2008-2012 and was the destination for 1 of every 11 telecom FDI projects locating in the U.S. More than 70% of the state's telecom FDI projects since 2008 located in the Dallas-Fort Worth metro area.

Key foreign telecom companies in Texas:

China
- *Huawei: U.S. HQ in Plano, TX*
- *ZTE: U.S. HQ in Richardson, TX*

Japan
- *Fujitsu: Corporate campus in Richardson, TX*

South Korea
- *Samsung Telecommunications: U.S. HQ in Richardson, TX*

Sweden
- *Ericsson: U.S. HQ in Plano, TX*

France
- *Alcatel-Lucent: Corporate campus in Plano, TX*

The Netherlands
- *Nokia Siemens: U.S. HQ in Irving, TX*

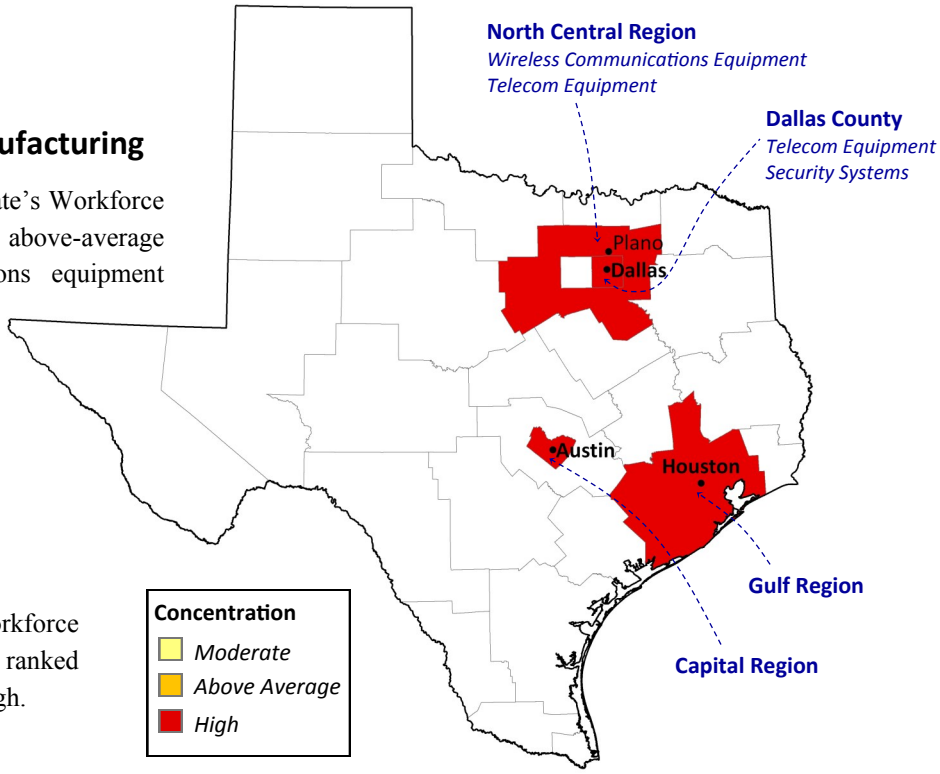
Canada
- *RIM: U.S. HQ in Irving, TX*

Workforce Concentrations

Telecom Equipment Manufacturing

The map at right identifies the state's Workforce Development regions with above-average specializations in communications equipment manufacturing. The highlighted regions are not the only areas in Texas where workers in this sector can be found, but rather represent areas with the greatest concentrations relative to the size of the local labor force.

Regions with significant workforce concentrations in this sector are ranked as moderate, above average, or high.



Source: Texas Workforce Commission

Telecom Giant Ericsson Expands North American HQ in Plano, Texas

In 2011, telecom equipment-maker Ericsson announced a $54 million expansion to the company's North American Headquarters campus in Plano, Texas. The Stockholm, Sweden-based firm employs around 3,000 in Plano and the surrounding area. Ericsson is the world's leading provider of telecom equipment by revenue, and the company's North Texas expansion reinforces the regional telecom cluster. Each of the world's top six telecom equipment companies have significant operations in Texas, including Ericsson, Huawei, Alcatel-Lucent, Nokia Siemens Networks, Cisco Systems, and ZTE.

Major Companies

Top Telecom Companies with Operations in Texas

Alphabetical

Company Name	Primary Location(s)	Sector	Sales (Millions)
3M	Austin	Telecommunications Equipment & Other Electronics	$29,611
Alcatel-Lucent	San Antonio, Austin, Plano	Telecommunications Equipment	$19,847
AT&T	Dallas, Austin, Richardson, San Antonio	Telecommunications Services	$126,723
BlackBerry (formerly Research in Motion)	Irving	Telecommunications Equipment	$18,435
Cisco Systems	Austin, Richardson	Telecommunications Equipment	$46,061
Crown Castle International	Houston	Telecommunications Services	$2,033
Ericsson	Plano	Telecommunications Equipment	$32,904
Fujitsu Network Communications	Richardson	Telecommunications Equipment	$54,294
GENBAND	Frisco, Plano	Telecommunications Equipment	$711
General Dynamics	Kilgore, Longview, Richardson	Communications Equipment	$32,677
Huawei Technologies	Plano	Telecommunications Equipment	$32,037
Logitech (LifeSize Communications)	Austin	Communications Equipment	$2,316
MetroPCS	Richardson	Telecommunications Services	$4,847
NEC Corporation	Irving	Computers & Telecom Equipment	$36,907
Nokia	Dallas, Irving, Austin	Telecommunications Equipment	$50,060
Nokia Siemens Networks	Irving	Telecommunications Equipment	$18,182
Qualcomm	Austin	Telecommunications Equipment	$19,121
Raytheon (Network CentricSystems)	McKinney, Dallas, Plano	Communications Equipment	$24,857
Rockwell Collins	Richardson	Communications Equipment	$4,726
Samsung Telecommunications	Richardson, Coppell	Telecommunications Equipment	$104,155
Verizon Communications	Irving, Richardson	Telecommunications Services	$110,875
ZTE	Richardson, Austin	Telecommunications Equipment	$13,551

Representative sample only. Sources: Dun & Bradstreet, LexisNexis, company websites

Electronic Instruments

Texas' electronic instruments workforce is the fourth largest in the nation, with 23,500 professionals employed at nearly 500 firms. This sector, which accounts for nearly 12% of electronics industry employment in Texas, produces a variety of precision instruments for aerospace and nautical navigation, electromedical applications, HVAC controls, industrial process sensors and controls, electrical testing equipment, flow meters, laboratory instruments, and other precision equipment.

Electronic instrument manufacturing is an important and growing sector of the Texas economy. Nationwide, the majority of electronics industry sectors shed jobs over the past decade, including electronic instruments, which saw employment fall by 11% from 2002-2012. In Texas, however, statewide employment in the electronic instrument sector in 2012 was up more than 11% versus ten years earlier. During this period, the State of Texas has invested in the sector through the Texas Emerging Technology fund, which has put more than $16 million into 14 electronic instrument-related deals since 2005 (see Appendix on page 30).

Texas is one of the **top 5** states in the nation for electronic instruments manufacturing jobs

Two subsectors dominate the Texas electronic instrument industry: 1) search, detection, and navigation instruments and 2) industrial process instruments. While companies in these subsectors export products globally, many have also evolved particularly to supply Texas' advanced oil and gas, petrochemical, aerospace, semiconductor, and other manufacturing industries.

The **search, detection, and navigation** (SDN) subsector makes instruments that guide ships and planes. Products include cockpit instruments, flight recorders, navigational systems, and radar equipment. Within Texas, the Dallas-Fort Worth metro area is home to nearly 65% of the jobs in this sector. The percentage of the Dallas-Fort Worth workforce employed in SDN instrument manufacturing is more than 50% higher than the national average.

California Electronic-ID Maker Builds New Production Facility in Texas

In September 2012, the Texas Enterprise Fund awarded a $1.9 million grant to HID Global, who announced a $35 million investment in a new manufacturing and distribution facility in Austin, Texas, for production of electronic security and ID systems.

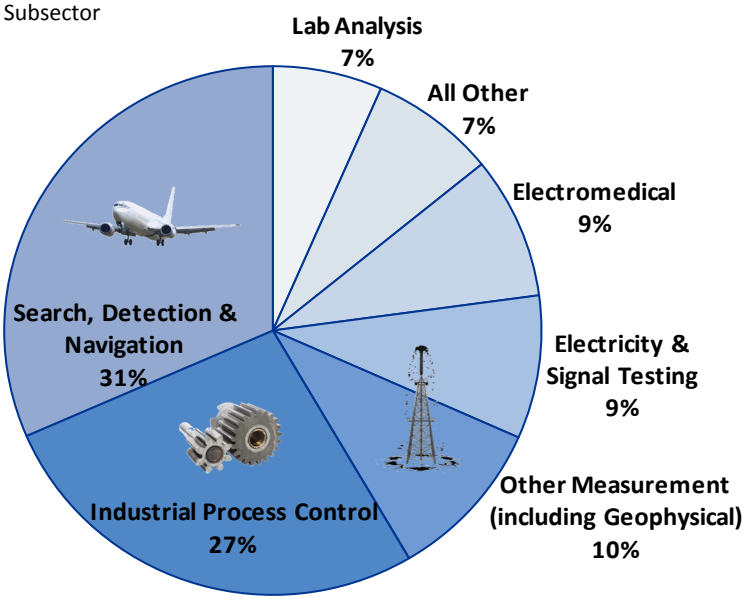
HID Global, a California-based leader in secure identity solutions, plans to create 239 jobs when the 200,000 sq. ft. facility is fully operational.

The **industrial process variable** (IPV) subsector produces devices that control industrial automation. Advanced manufacturing techniques require electronic instruments for automation and process controls, which enable modern factories to operate efficiently. These instruments measure or control variables, such as temperature, pressure, combustion, flow, viscosity, etc. The percentage of the Houston metro workforce employed in IPV instrument manufacturing is nearly three times the national average. The Houston area

workforce is also highly specialized in manufacturing measurement devices, such as geophysical instruments, as well as fluid meters and related counting devices (see page 28).

Texas Electronic Instrument Employment

by Subsector



Austin-Based National Instruments Announces 1,000-Job Expansion

In February 2013, National Instruments (NI) announced a major expansion to its headquarters campus in Austin, Texas. Supported by a $4.4 million grant from the Texas Enterprise Fund, this $80 million expansion of NI's research & development capacity will add 1,000 new workers to the company's Austin workforce.

NI is a leading provider of automation, test, and measurement solutions to a wide range of high tech industries and is one of the largest private employers in Austin, where it currently employs over 2,400.

NATIONAL INSTRUMENTS

Electronic Instrument Manufacturing Employment in Texas

Second Quarter 2012

Subsector (Industry Code)	Employees	Firms	Average Annual Wage
Electromedical Apparatus Manufacturing (334510)	2,047	50	$114,296
Search, Detection & Navigation Instrument Manufacturing (334511)	7,419	47	$104,364
Automatic Environmental Control Manufacturing (334512)	391	30	$45,708
Industrial Process Variable Instruments Manufacturing (334513)	6,339	158	$77,636
Fluid Meters and Counting Devices Manufacturing (334514)	1,323	22	$64,688
Electricity & Signal Testing Instruments Manufacturing (334515)	2,061	76	$72,280
Analytical Laboratory Instruments Manufacturing (334516)	1,552	32	$70,304
Irradiation Apparatus Manufacturing (334517)	69	13	$90,636
Other Measuring and Controlling Devices Manufacturing (334519)	2,330	77	$52,416
TOTAL	**23,531**	**493**	**$84,604**

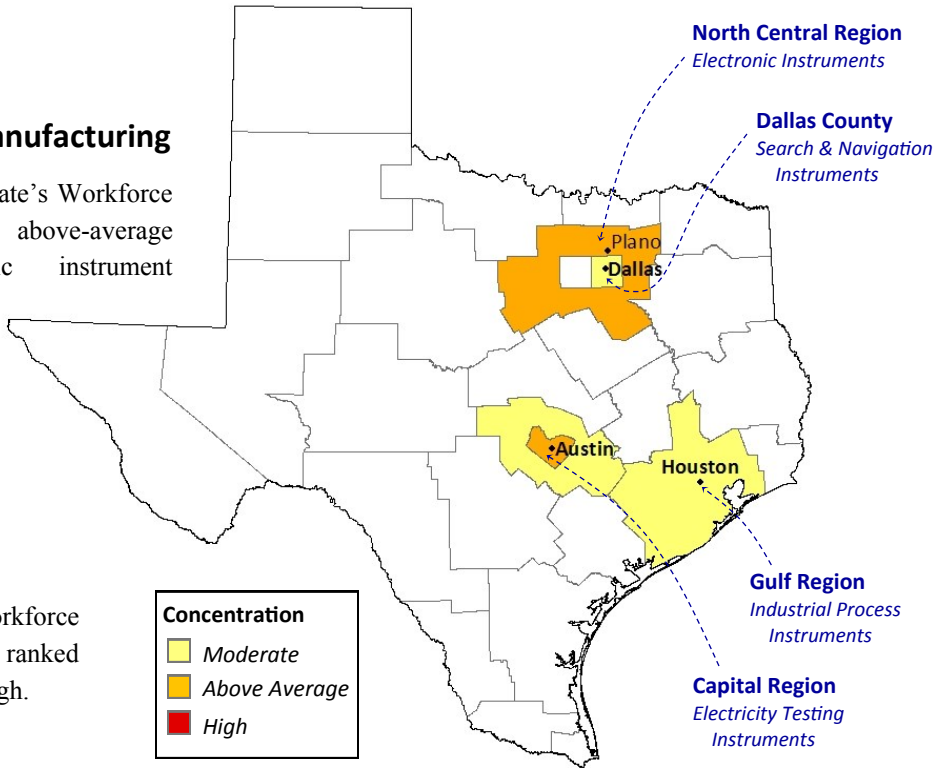
Source: Texas Workforce Commission

Workforce Concentrations

Electronic Instrument Manufacturing

The map at right identifies the state's Workforce Development regions with above-average specializations in electronic instrument manufacturing. The highlighted regions are not the only areas in Texas where workers in this sector can be found, but rather represent areas with the greatest concentrations relative to the size of the local labor force.

Regions with significant workforce concentrations in this sector are ranked as moderate, above average, or high.



Source: Texas Workforce Commission

Emerson Process Management Opens the Valve in Texas

In recent years, Minnesota-based Emerson Process Management (EPM), a division of diversified technology company Emerson Electric, has been actively expanding its Texas operations. In 2012 alone, no fewer than four separate Emerson expansions were underway in Texas.

In 2012, EPM Process Systems & Solutions and Plant-Web divisions moved to a new facility in Round Rock, Texas to support the expanding plant automation business. Also in 2012, EPM Regulator Technologies broke ground on a $25 million location for its pressure regulator and relief valve operations in McKinney, Texas. In North Houston, EPM Valve Automation broke ground on a $30 million campus geared toward the energy industry. Meanwhile, the $34 million Emerson Industry Center for Hydrocarbon and Energy opened in West Houston, which was the result of a consolidation of eight offices in the Houston area.

EPM's other electronic instrument divisions with significant operations in Texas include Bettis, Daniel Measurement & Control, Remote Automation Solutions, Rosemount Analytical, and Roxar in Houston, as well as EIM in nearby Missouri City. Statewide, EPM employs about 650 workers across all divisions.

New Emerson facility in Houston. Photo courtesy of EPM.

Major Companies

Top Electronic Instrument Companies with Operations in Texas

Alphabetical

Company Name	Primary Location(s)	Sector/Subsidiary or Division	Sales (Millions)
BAE Systems	Austin, Fort Worth	Navigation & Targeting Systems	$27,703
CGGVeritas	Houston	Seismic Imaging	$2,942
DRS Technologies	Dallas	Imaging & Targeting Systems	$1,299
Elbit Systems	Fort Worth	Electronic Instruments	$2,817
Emerson Process Management	Houston, McKinney, Missouri City, Round Rock	Industrial Process Controls, Automation & Gas Chromatography	$24,412
ENGlobal Corp	Houston	Industrial Process Controls & Sensors	$313
ESCO Technologies	Cedar Park	Electronic Measurement & Testing Instruments	$1,122
Garrett Electronics	Garland	Metal Detectors	$27
Honeywell	Richardson, El Paso, Austin	Microswitches & Sensors, Security & Detection Devices	$36,529
Invensys Controls	Plano, Houston	Industrial Process Controls & Sensors	$4,059
ION Geophysical Corp	Houston	Seismic Imaging	$455
Kongsberg Maritime	Houston	Navigation & Sensors	$2,694
Ludlum Measurements	Sweetwater	Radiation Measurement Instruments	$43
Megger Group	Dallas	Electronic Measurement & Testing Instruments	$153
National Instruments	Austin	Industrial Process Controls & Sensors	$1,024
Pason Systems	Cedar Park	Industrial Process Controls & Sensors 3PS Inc.	$327
Rigaku Corporation	Austin, Houston	Elemental Analysis Instruments	$300
Textron	Austin	Electronic Instruments	$11,275
Thermo Fisher Scientific	Austin, Sugar Land, Houston	Industrial Process Controls & Gas Chromatography	$11,726
Thermon	San Marcos	Industrial Process Controls & Sensors	$271
Toshiba	Houston	Industrial Process Controls & Sensors	$38,999
Ultra Electronics	Austin, Round Rock	Navigation & Sensors	$1,131
Yokogawa Corporation	Sugar Land	Industrial Process Controls & Sensors, Test & Measurement Instruments	$4,067

Representative sample only. Sources: D&B, LexisNexis, company websites

Appendix: Texas Emerging Technology Fund—High Tech Awards

Company/Entity	City	Project Description	Funding
1st Detect Corporation	Austin	Mass spectrometer	$1,800,000
21-Century Silicon	Richardson	Solar-grade silicon manufacturing	$3,500,000
Advanced Receiver Technologies	Dallas	Digital baseband receiver	$250,000
Agile Planet	Austin	Robotic control in advanced manufacturing	$1,000,000
AgileMesh	Richardson	Surveillance equipment	$2,000,000
Alliance for Higher Education	Richardson	Atomically Precise Manufacturing	$4,700,000
Axelo	Austin	Motion-sensing 3D game controller	$250,000
Biscotti	McKinney	HD Video calling	$1,000,000
Calxeda	Austin	Low-power system-on-a-chip server	$1,000,000
Carbon Nanotechnologies	Houston	Single-walled nanotubes	$975,000
Device Fidelity	Richardson	Removable secure transaction chipcards	$3,000,000
Faradox Energy Storage	Austin	High-energy capacitors	$1,000,000
FibeRio Technology Corporation	Edinburg	Nanofiber fabrication equipment	$1,500,000
Firefly LED Lighting	Austin	LED lamps	$3,000,000
Hanson Robotics	Richardson	Animatronic robotics	$1,500,000
InView Technologies Corporation	Austin	High-performance infrared cameras	$1,500,000
Iridescent Networks	Frisco	Network comm. node for low-latency switching	$1,000,000
itRobotics	Stafford	Oil & Gas pipe inspection	$750,000
Merkatum	Austin	Biometric ID devices	$1,000,000
Molecular Imprints	Austin	Imprint lithography	$3,000,000
NanoComposites	The Woodlands	Nanotechnologies	$1,500,000
Nanocoolers	Austin	Nanoelectronic cooling system	$3,000,000
NanoTailor	Austin	Single-walled nanotubes	$250,000
OptiSense Network	Bridgeport	Electro-optic HV sensor	$1,500,000
Photodigm	Richardson	Semiconductor diode laser	$749,829
PrincipleSoft	Plano	Wireless video transmission	$750,000

Company/Entity	City	Project Description	Funding
RFMicron	Austin	Self-tuning RFID integrated circuits	$925,000
Sematech Corporation	Austin	Immersion lithography	$5,000,000
SmartField	Lubbock	Remote sensing for precision agriculture	$1,000,000
SNRLabs	Richardson	Wireless convergence manager	$750,000
Solarno	Coppell	Carbon nanotube sheets	$250,000
StarVision Technologies	College Station	Optical based guidance & navigation systems	$750,000
Stellarray	Austin	Flat-panel X-ray technology	$750,000
Syndiant	Dallas	Personal media projector	$3,500,000
Texas State University	San Marcos	Center for Multifunctional Materials	$4,200,000
Texas Tech University	Lubbock	Nanotechnology Center	$2,100,000
The University of Houston System	Houston	Superconductivity Applied Research Hub	$3,675,000
The University of Texas at Dallas	Richardson	Future Semiconductor Commercialization (FUSION)	$5,000,000
The University of Texas at Dallas	Richardson	Texas Analog Center of Excellence (TxACE)	$4,725,000
The University of Texas at El Paso	El Paso	3D Integrated Systems Technology	$3,510,000
The University of Texas System	Arlington, Austin, Richardson	Southwest Alliance for Nanotechnology (SWAN)	$1,750,000
The University of Texas System	Arlington, Austin, Richardson	Southwest Academy of Nanotechnology	$10,500,000
Veros Systems	Houston	Remote electric motor sensing	$1,500,000
Xitronix Corporation	Austin	Nanoscale electronic testing devices	$500,000
TOTAL	—	—	**$91,859,829**

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